

REDETERMINATION OF PARAMETERS FOR SEMI-EMPIRICAL MODEL FOR SPALLOGENIC He AND Ne IN CHONDRITES. L.E. Nyquist, SN4/NASA Johnson Space Center, Houston, TX 77058 and A.F. McDowell, Lunar and Planetary Institute, 3303 NASA Rd 1, Houston, TX 77058

The semi-empirical model described previously (1,2) satisfactorily reproduced a number of shielding-dependent variations in the relative production rates of spallogenic He and Ne in chondrites. However, data for cores of the Keyes and St. Severin meteorites (3,4) showed a subsurface build-up in ^{3}He which was not predicted with the original model parameters and the model was not pursued. Renewed interest in the preatmospheric size of meteorites, spurred in part by the desirability of understanding the exposure history of the SNC meteorites, justifies redetermination of model parameters.

In the semi-empirical model (5) the production rate of nuclide i is

$$P_i = A_i[e^{-\mu_a d} - B_i e^{-\mu_s d}]$$

where $\mu_j = N\rho\sigma_j/A$, j = a,s. N is Avogadro's number and A and ρ are the average atomic weight and the density, respectively, of the meteoritic material. σ_a and σ_s are the interaction cross sections for primary and secondary cosmic rays, respectively. Values of μ_a and μ_s were obtained by scaling the values determined by (5) for the Grant iron meteorite assuming that σ_a and σ_s are proportional to $A^{2/3}$(1). In principle, these parameters can also be independently determined from the Keyes and St. Severin data. However, this was not attempted since it was found to be possible to fit those data by varying only the A_i and B_i.

Values of A_i and B_i obtained from various applications of the model are summarized in Table 1. It is possible to obtain good fits to the concentration gradients of ^{3}He, ^{21}Ne, and ^{22}Ne with depth and to reproduce the ^{3}He/^{21}Ne vs. ^{22}Ne/^{21}Ne trends in the Keyes and St. Severin meteorites with the same model parameters. It is also possible to reproduce the "Bern line" (6) by varying the size of the model meteoroids. However, in this latter case, different model parameters are required than those which yield fits to the Keyes and St. Severin data. This result is a consequence of the fact that the ^{3}He/^{21}Ne-^{22}Ne/^{21}Ne trends for the individual meteorites do not parallel the "Bern line". It is possible to mimic the general trend of the "Bern correlation" by juxtaposition of a family of lines calculated with the same B_i as used for Keyes and St. Severin by assuming that all meteoroids are similar in size and by varying the values of A_3/A_{21} and A_{22}/A_{21} within the limits given in Table 1 for the "Bern family". One possible physical interpretation of this result is that the effective cosmic ray flux varies for different meteorites, perhaps due to a spatial concentration gradient which affects primarily the lower energy particles.

TABLE 1. MODEL PARAMETERS

	A_3	A_{21}	A_{22}	A_3/A_{21}	A_{22}/A_{21}	B_3	B_{21}	B_{22}
St. Severin	17.6	4.78	4.63	3.68	0.968	0.91	0.97	0.947
Keyes	31.6	8.21	8.29	3.85	1.01	0.91	0.97	0.953
Bern line				3.3	1.04	0.85	0.97	0.954
Bern family				2.4-5.5	0.965-1.11	0.91	0.97	0.953

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